PLANT PROTECTION BULLETIN

A Publication of the
WORLD REPORTING SERVICE ON PLANT DISEASES AND PESTS

VOL. III, No. 5 FEBRUARY 1955

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
ROME, ITALY

FAO PLANT PROTECTION BULLETIN

is issued as a medium for the dissemination of information received by the World Reporting Service on Plant Diseases and Pests, established in accordance with the provisions of the International Plant Protection Convention, 1951. It publishes reports on the occurrence, outbreak and control of pests and diseases of plants and plant products of economic significance and related topics, with special reference to current information. No responsibility is assumed by FAO for opinions and viewpoints expressed in the Bulletin.

Manuscripts for publication, or correspondence regarding the World Reporting Service, should be addressed to Dr. Lee Ling, Plant Production Branch, Agriculture Division, FAO, Viale delle Terme di Caracalla, Rome, Italy; subscriptions and other business correspondence to Documents Sales Service, FAO, Viale delle Terme di Caracalla, Rome, Italy.

The Bulletin is issued monthly in English, French, and Spanish, and twelve numbers, commencing with the October issue in each year, constitute a volume. Subscription rates are $3.00 or 15s. per annum; single numbers are priced at $0.30 or 1s. 6d. The citation is FAO Plant Protection Bulletin, or, in abbreviation, FAO Plant Prot. Bull.

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FAO Plant Protection Bulletin

Vol. III, No. 5 A Publication of the February 1955

World Reporting Service on Plant Diseases and Pests

Insect Pest Problems in Chile

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Chile, owing to its geographical position, has few of the more destructive insect pests of American agriculture. The most serious pests of crops in neighboring countries are still unknown in Chile, perhaps because its natural barriers – the Pacific Ocean, the Andes, the deserts in the north and the cold climate in the extreme south – prove insurmountable.

On only a few occasions have insects entered the country unaided and almost all recognized pests have been introduced by man himself. Locust swarms are unknown and the last invasion, which occurred in 1917, came from Argentina by the south, where the Andes are lower, and caused more alarm than damage.

Available historical data indicate that the introduction of insect pests started in the early days of the discovery and conquest of the country by the Spaniards. There are signs that this invasion is continuing. During the last thirty years, new insects have been added to the number of destructive species, despite the fact that a government service for preventing the introduction and establishment of crop pests has been maintained for over half a century.

Comparison of the first brief list of the native and exotic insects, compiled by Philippi in 1885, with the very long ones published by the Ministry of Agriculture during the last ten years, reveals how the situation has changed.

A peculiar feature is the natural limitation of Chilean pests. The fact that no species is uniformly distributed along the country's meridional length of 4,300 km., between 17° and 56° S., can be explained in ecological terms. There is a progressive latitudinal, and a general and sometimes abrupt altitudinal, variation. The country, covering a long strip of land, shows wide differences of climate, ranging from the hot desert to the lake or very cold region. Thus most of the pests are localized and only those which attack stored products have, for obvious reasons, a wider distribution.

The last list of pests, published by the Ministry of Agriculture in 1953, is long but gives only names. There has been no publication dealing with the subject fully. The present notes summarize information on the insect pests of biological and economic importance, with special reference to those pests which have been effectively controlled, and those which require further study.

Insects of Grain Crops

Wheat covers approximately 800,000 hectares of the 1,100,000 hectares cultivated to grains. The yields are not high, averaging somewhat more than one ton of grain per hectare, and are still lower in some localities where rust diseases and insect attacks occur almost permanently or periodically. The most harmful lepidopterous insects are the four armyworms: *Pseudaletia impuncta* (Guen.), *Protoleucania albilinea* (Hbn.), *Cirphis unipuncta* (Haw.) and *Feltia annexa* Treit. The first mentioned species also attacks barley.

Various species of Scarabaeidae are serious pests of wheat in the south; for instance, St. John's brown beetle, *Athlia rustica* Erichs.,

occurs from Coquimbo to Curicó; another species, *Phytholoema herrmanni* Germ., ranges from Chillán to Panguipulli; two Rutelid beetles, *Hylamorpha elegans* (Burm.) appears from Bio–Bio to Aysén, and *H. cylindrica* Arr. from Aconcagua to O'Higgins. In Cautin, the annual loss due to the grubs of *Hylamorpha* has been calculated as equal to the crops on 20,000 hectares or approximately 20,000 tons of wheat. Furthermore, adult *H. elegans* and the other beetles cause serious damage by defoliating wild forest trees, particularly *Nothofagus*. Experiments are being carried out with milky disease caused by *Bacillus popilliae* to control *H. elegans*. Many growers rely on the fungus *Metarrhisium anisopliae*, which in some places has significantly reduced the density of the grub population. In the south, several species of Scarabaeidae are attacked by certain wasps of the Thynnidae family and also by such birds as the chimango (*Milvago chimango*). The results of the most recent experiments indicate that chemical control with aldrin and BHC is effective, particularly if the insecticide is applied in late spring (on fields to be sown with wheat in autumn), when the females go underground to oviposit.

Other insects of minor importance on wheat but harmful to oats are the green aphid, *Toxoptera graminum* (Rond.) and the crane fly, *Tipula apterogyne* Phil.

On maize the most common pest is the corn earworm, *Heliothis armigera* (Hbn.). At Arica in the extreme north, the cutworm, *Prodenia eridania* Cram. is also prevalent. Attacks by the lesser cornstalk borer, *Elasmopalpus lignosellus* (Zell.) frequently necessitate the resowing of maize in farms in the central region. The farmer sees the crop wilting and decides either to irrigate or to re–sow, but seldom realizes that the destruction of the plant is caused by this borer, which is difficult to control.

The Angoumois grain moth, *Sitotroga cerealella* (Oliv.), although not found in continental Chile, is the chief maize pest on Easter Island, the Chilean possession in Polynesia, where eradication measures have failed. The importation of maize from Easter Island to Chile is therefore still prohibited.

Rice is occasionally attacked by grasshoppers (*Dichroplus* spp.).

Insects of Forage Plants

In the valleys of the extreme north, particularly in Lluta, alfalfa (*Medicago sativa*) is so severely damaged by armyworms, the larvae of various lepidopterous insects (*Leptotes*, *Hemiargus*, *Hylephila*) which destroy 4 of the 6 cuts produced, that many farmers have given up growing alfalfa. Of the many measures which have been tested for armyworm control, two have given promise and are now being tried out: one is the propagation of a tachinid parasite (*Incamyia chilensis* Aldr.) and the other consists in applications of BHC and aldrin insecticides.

In the central region some grasshoppers, mostly of the genus *Dichroplus*, that attack alfalfa are endemic.

The Tongoy sheep ranches are infested with a stinkbug *Acledra dimidiaticollis* (Spinola) which destroys saltbush (*Atriplex semibaccata*) and for which no effective, cheap control method is yet known. Under the very special steppe conditions of the ranches, it is not worthwhile investing large sums of money in preventive measures.

The area under clovers (*Trifolium*), which has been widely grown in the past, has shrunk. Chile, at one time an exporter, now imports seed. Many clover fields in the central region are disappearing. Although insects may not be the sole cause of this change, it is very significant that in the Cachapoal Valley some farmers no longer sow this legume as the seed crop is greatly reduced by the clover seed weevil, *Bruchidius* sp., which causes damage similar to that of clover seed chalcid, *Bruchophagus gibbus* (Boh.). Mites (Tetranychidae), though common in clover and alfalfa fields in Chile, have not yet been fully studied.

The grass cutworm, *Dalaca noctuides* Pfitz., is undoubtedly the main factor limiting stock farming on clovers, orchardgrass (*Dactylis glomerata*) and ryegrass (*Lolium* sp.) in the ranges from Cautín to Osorno. Studies now being carried out on the control of this Hepialid are directed towards establishing resistant meadows, as fescue (*Festuca*) and oatgrass (*Arrhenartherum elatius*) are not seriously damaged. It is also planned to popularize the use of DDT, methoxychlor and aldrin; BHC has proved ineffective. The insecticides, at the rate of 700 to 1,500 gm.

per hectare, should be applied on the soil surface in August because cutworms come to the surface at night and are more vulnerable at that time of the year. Trampling by livestock is another satisfactory means of control.

Another clover pest, the slug (*Agriolimax*), occurs in the southern limits of the cutworm area of distribution. Much further south in continental Chiloé, grasshoppers have been destroying pastures and crops periodically for more than ten years, and causing starvation of livestock. Although the foci are relatively small, the difficulty in handling equipment over large stretches of land with a bad climate and no roads has hindered control operations. Chile and Argentina are now co-operating in a study of grasshoppers.

Insects of Truck and Garden Crops

Apart from the infestation of germinating seed, primarily by the seed corn maggot, *Hylemyia cilicrura* Rond., and the seed potato maggot, *Phorbia trichodactyla* Rond., common beans also suffer from other pests and consequently this pulse is not grown in many localities. Methods for the control of the bean moth, *Epinotia opposita* Heinr., the common bean weevil, *Acanthoscelides obtectus* (Say.), and leafhoppers (*Empoasca*, *Atanus*) require to be studied. It is probable that the first two species can be controlled by regulating sowing dates and also by insecticidal treatment when the egg-laying females are roving over the plants. The leafhoppers are particularly dangerous, because they are usually vectors of virus diseases.

The small black beetle, *Blapstinus punctulatus* Solier, has been found to show a marked preference for young plants, not only of beans but of muskmelons (*Cucumis melo*), watermelons, tomatoes, maize, etc. Older bean plants may be completely defoliated by another coleopterous insect, *Listroderes subcinctus* Boh., which is very widespread in early summer.

Green peas have two important pests: the pea weevil, *Bruchus pisorum* (L.), which impairs the quality of the pea, and the onion thrips, *Thrips tabaci* Lind., which limits pea crops for canning purposes. The biology of the pea weevil has been fully studied, and it can be controlled by application of a proper insecticide just before the female oviposits.

Lentils (*Lens culinaris*) are also attacked by two serious but localized pests: the crane fly, *Tipula apterogyne*, and the cutworm, *Agrotis suffusa* Gmelin.

More information on the insects attacking legumes in Chile may be found in a previous report on this subject [1].

Potatoes, which are cultivated throughout the country, are attacked by numerous insect species. The potato tuberworm, *Gnorimoschema operculella* (Zell.), is controlled by the natural parasite *Arrenoclavus köhleri* (Blanc.), an Encyrtid which was introduced ten years ago from Chile to North America, and then to Australia and Europe in order to combat the potato tuberworm. The potato blister beetle, *Epicauta pilmus* Molina, a Meloid defoliator, is controlled easily by hand collection and by DDT. Leafhoppers and plant lice cause the most concern because of their ability to transmit diseases, but it is hoped that areas may be found between the latitudes of 43° and 46° S. where the potato can be cultivated free from these vectors.

Tomato pests include the tomato fruitworm, *Heliothis armigera* (Hbn.), the potato tuberworm and, most important, the tomato fly, *Rhagoletis ochraspis* Wied. Some centers of dispersion of the tomato fly are Antofagasta, Copiapó, Quillota, Concón and La Cruz. This pest, invasion by which is dreaded by many countries, causes an annual loss of 2,500,000 boxes of tomatoes for export. No control method has been perfected.

Poor onion crops are caused by *Thrips tabaci*, which also attacks many other plants, including the watermelon, on which it induces flower malformation, leaf curling and necrosis.

Cucurbits in the valleys of the north are severely damaged by the pickelworm, *Diaphania nitidalis* (Stoll.), and muskmelons and watermelons in central Chile by *Hylemyia*.

In the Quillota valley, where artichokes (*Cynara scolymus*) are grown intensively, they are attacked by three important insects against which there are no fully satisfactory control methods: these are the artichoke bug, *Lygus fraudulentus* Stal., the melon

[1] Olalquiaga, F. G. Pests of edible legumes in Chile. *FAO Plant Prot. Bull.* 1 : 166-168. 1953.

aphid, *Aphis gossypii* Glov., and a leaf miner. Infestation by the artichoke bug often reduces the size of the heads of artichoke and causes discoloration and withering of the leaves.

The growing of strawberry (*Fragaria chiloensis*) in the central region is gradually disappearing, largely owing to strawberry rootworms which destroy the plants underground. The white-fringed beetle, *Pantomorus leucoloma* (Boh.), has been identified, but other Curculionids are undoubtedly involved.

Among the few insect pests attacking tobacco there may be mentioned the potato tuberworm, which tunnels into the young plants. Although cultivation of the sugar beet is considered commercially satisfactory over a vast stretch of the country, there are two virus diseases, viz. yellow wilt and curly top, that cause considerable losses; *Atanus exitiosus* Beamer, a possible insect vector, is widespread in Chile. Research on the subject ceased in 1947.

Insects of Fruits and Olives

Mites (Tetranychidae), of which there are no doubt more than one species, attack nearly all fruit trees and grapes. The San José scale, *Quadraspidiotus perniciosus* Comst., an insect which could not be eradicated and for which there is no effective biological control, infests most rosaceous plants and causes heavy losses to the fresh fruit export trade. Aphids are also a serious problem.

Peach trees in the central region show a silvering and leaf curling caused by the peach silver mite, *Vasates cornutus* (Banks). In some orchards of plum (*Prunus domestica*) in the central region (La Cruz, Codao, etc.) about 10 percent of the trees have injurious lesions at the collar, caused by *Lophotus phaleratus* Erichs., one of the most common Curculionids.

The South American fruit fly, *Anastrepha fraterculus* Wied., which was a pest of fruit trees in the north, has been eradicated, and apart from the Chilean cherry fruit flies (*Euribia conversa* Brethes and *Pterotaenia fasciata* Wied.) which are of little importance, there are no other fruit flies.

Apple and walnut (*Juglans regia*) are attacked mainly by the codling moth, *Carpocapsa pomonella* (L.). The woolly apple aphid, *Eriosoma lanigerum* (Hausm.), is no problem since it is controlled by the Encyrtid parasite *Aphelinus mali* Hald.

Thrips cause leathery fruits. Among them, *Graphidothrips stuardoi* Moult. has been found on fig trees, *Heliothrips haemorrhoidalis* (Bouché) on the avocado, and *Taeniothrips frici* (Uzel), *Frankliniella cestrum* Moult. and *Haplothrips* spp. on plums.

Among the most dangerous pests of citrus, *Pseudococcus* is being controlled by its natural enemies, and the cottony-cushion scale, *Icerya purchasi* Mask., ceased to be a problem after the introduction of the Australian lady beetle, *Rodolia cardinalis* Muls., and the Agromyzid parasite *Cryptochaetum iceryae* Will. Many serious cases of damage to citrus caused by the purple scale, *Lepidosaphes beckii* (Newm.), were seen in Azapa, but the growers no longer need to spend money on the control of this pest on the 8,000 hectares under cultivation, especially in the central region.

The most common pest of the olive is the black scale, *Saissetia oleae* (Bern.). Despite the introduction of many natural enemies the growers still have to spend millions of pesos on mineral oils to treat 12,000 or more hectares of olive groves. In Azapa the black scale was appreciably reduced by its parasites, but the olive trees were covered with the hemispherical scale, *S. hemisphaerica* (Targ.), against which many control methods proved ineffective. For over a decade the olive beetle borer, *Hylesinus oleiperda* F., has necessitated annual pruning. This borer makes short but destructive galleries in the small branches and is common in the environs of Rengo. For some years in districts of Ovalle, the olive flowers have been abortive; this was blamed on grasshoppers (*Dichroplus*) but it has been shown that the damage is caused by a small Tettigoniid which lays its eggs in the flowering shoots.

In the interior, grapes are attacked by three serious pests, the biology of which is being studied with a view to the more effective use of insecticides. The ground pearl, *Margarodes vitium* Giard., attacks the plant underground and its injury is usually confused with that caused by phyllo xera (*Phylloxera vitifoliae* Fitch), which does not occur in Chile. The origin, biology, habits and control of *M. vitium* form one

of the most absorbing subjects of study in national economic entomology. The European peach scale, *Lecanium persicae* (F.), and the citrus beetle, *Pantomorus xanthographus* Germ., destroy much of the foliage and grapes.

Insects of Forest Trees

Forest trees are attacked by insects of the most varied habits. Among those which stunt the trees in plantations or cause them to wither, mention may be made of the pine Adelgid, *Chermes boerneri* Annaud (= *Pineus boerneri* Annaud), on *Pinus radiata*, and the oak scale, *Asterolecanium variolosum* Ratz., on *Quercus*. Borers attacking trees in natural forests include *Langsdorfia* spp., *Dexicrates robustus* Blanch. and *Chiasmetes limae* (Guér.). *C. boerneri* is also destructive on pine in natural forests and *Pterocomma salicis* (L.) on *Populus*. Various lepidopterous insects, mostly indigenous, are the principal leaf feeders; mention may be made of the genera *Polythysana*, *Catocephala*, and *Macromphalia*. Seed-eating insects include weevils, *Apion tenebricosum* Gemminger, etc. Insects which attack seasoned wood include *Cryptotermes brevis* Wlk., *Neoterius mystax* Blanch. and *Polycaon chilensis* (Erichson). Official recommendations have tended mainly towards the control of the three pine pests: *C. boerneri*, *Catocephala amphinome* (F.) and *Macromphalia dedecora* Feisth.

Forest entomology studies will no doubt be intensified as a result of the recent establishment of the School of Forestry in the University of Chile.

Insects of Flowers

There are many localities along the central valley where insects cause severe damage to flowers. One species of thrips, *Taeniothrips simplex* (Mor.), attacks gladioli and another, *Aeolothrips fasciatipennis* Blanch., infests the Chilean national flower, the "copihue" or Chilean bellflower (*Lapageria rosea*). The most common pest of rose bushes is the rose aphid, *Macrosiphum rosae* (L). Chrysanthemums, also widely cultivated for flowers, are attacked by insect pests which are not fully determined.

Insects of Stored Products

Insects, mites, rodents and fungi cause losses during the storage and handling of grains. The principal insect pest is the granary weevil, *Sitophilus granarius* (L.) which should be controlled on a nation-wide scale by entirely changing existing storage, transport and preservation methods. The action of mites (*Tyroglyphus* spp.) becomes apparent when products remain long in freight cars or in inadequately equipped storerooms, and especially when left exposed to the rain. The over–all plan for the control of the pests of stored products, especially wheat, entails considerable expenditure and investment and it is being included in the general program for agriculture and livestock development which will be put into effect with aid from FAO and the International Bank. The two widely distributed insects of stored grains, *Sitotroga cerealella* (Oliv.) and *Rhyzopertha dominica* (F.), do not occur in Chile.

Losses in cheese factories are caused by the cheese skipper, *Piophila casei* L., the eradication of which requires ingenuity rather than insecticides, since its distribution is much more restricted and very closely connected with methods of cheese processing.

Weed Control by Insects

A number of insects attack weeds in Chile and some of these have been introduced into other countries. Chile has also obtained from abroad two species of the genus *Chrysolina* that feed solely on St. John's wort (*Hypericum perforatum*), a weed which is beginning to spread in Chile. It is also planned to introduce from Europe insects which attack the bramble (*Rubus ulmifolius*), which is overrunning no less than 1,500,000 hectares of crop land.

Erosion and Insects

It is commonly observed that insects are an additional cause of erosion and examples are not lacking in Chile. From time immemorial the brown-wing grasshopper, *Trimerotropis ochraceipennis* Blanch., has lived on wild plants and by leaving exposed vast

areas of hills and slopes has paved the way for erosion. The Chagual big moth, *Castnia eudesmia* G. R. Gray, is another insect which has contributed to the scarcity of " puyas " (*Puya chilensis* and *P. alpéstris*) in areas that were once not so barren. *Tipula apterogyne*, many indigenous Lepidoptera, and especially the Scarabaeids, sometimes lead to complete soil depletion.

Pest-free Crops

Attention may be drawn to the healthy condition of many crops, for instance: hemp (*Cannabis sativa*); sweet marjoram (*Origanum majorana*), protected from aphids by a Cocconellid, *Hippodamia convergens* (Guér.) in many valleys of the Arica area; the loquat (*Eriobotrya japonica*), a fruit tree which is currently grown in mixed plantations or family orchards; lettuce; rice; sugar cane, etc.

Insects and Climate

Chile has absolutely dry springs and summers, while rain falls in the winter when it is least needed. Consequently some pests, favored by the climate, cause a particular type of damage, as in the case of the red mite that prematurely defoliates some forest trees in mid-summer, the leaf fall appearing as quite a normal phenomenon. The very late sowings of beans and green peas are largely free of the usual weevil infestation because the low temperature inhibits egg laying at that time. Many failures in biological control can probably be attributed to climate.

Conclusions

Although some of the very destructive and widely distributed insect pests are not yet known to exist in Chile, it has been estimated that the total loss caused by insect pests to the national crop production is within the range of 15 to 20 percent. The solution of this serious problem requires that greater impetus be given to research and control programs. For instance, the introduction of the greatest possible number of entomophagous insects is highly desirable as it involves no expenditure on the part of the growers. More emphasis should be given to the investigation and application of improved cultivation methods for the prevention of losses, which until now has been overlooked in favor of the costly chemical control measures. The search and propagation of resistant plants will also undoubtedly lead to the reduction of damage by certain insects. The greatest handicap to achieving these aims lies in the shortage of entomologists in the country and it is imperative that a training program be instituted as soon as possible to meet the more urgent requirements.

Buba or Cushion Gall of Cacao in Nicaragua

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AN abnormal condition characterized by hypertrophy of the flower cushions has been found developing along the fan-branches and on the trunks of old cacao trees in Nicaragua. It also occurs on suckers and occasionally on trees between three and four years of age. The affected trees, particularly the older ones, become unproductive. From the abnormally enlarged cushions occasionally a few normal flowers may develop and eventually grow into full-sized pods, but such a phenomenon is uncommon. The affected parts of cushions resemble dark brown, cauliflower-like, hemispherical galls varying in size from 1/3 to 3 inches in diameter. In some cases more than one gall arises from a single flower cushion (Figure 1).

This conditions is known as " buba " or cushion-gall disease.

Previous Records and Related Diseases

Rorer (4) in 1911 mentioned a condition, somewhat similar to that described, on a few scattered trees in Trinidad called " male " cacao. Nowell (2) in 1923 described the presence of excrescences on trunks of cacao trees in the Lesser Antilles.

Cushion gall was observed by Kevorkian (1) in 1945 in the Rivas area of western Nicaragua, where he estimated that the proportion of affected cacao trees was about 25 percent, and in a few plantations it reached 50 to 75 percent. This extent of disease incidence has since been corroborated. Recent surveys (3,5) also revealed that in Nicaragua the disease has spread along the Escondido river and reached as far north as Granada.

Kevorkian also reported the presence of cushion gall in the Bocas del Toro area of Panama, where the disease was not as abundant as in Rivas. He observed small knobs of galls on the floral cushions of cacao trees grown in the Canal Zone Experimental Garden and also in an abandoned cacao plantation in Panama along the highway between Summit and Gamboa.

In Costa Rica, Orellana [2] very recently observed on cacao trees a cushion gall similar in appearance to that found in Nicaragua. However, the gall-like formation on flower cushions of more common occurrence (Figure 2) in cacao trees in Costa Rica is apparently related to self-incompatibility and does not seem to be identical with the cushion gall disease referred to by Kevorkian. It is possible that this type of abnormal growth is the same kind as that reported from Trinidad on " male " cacao.

Small knobs or galls of yet another type also occur on the flower cushions of cacao trees in Costa Rica and in Nicaragua. They may be found sometimes also at the insertion of large suckers. In several samples, enlarged and elongated knobs appeared to have developed from adventitious roots of the suckers. When these knobs were sectioned, they were found to consist of hardwood; they were not the same as the " buba " or cushion gall. In many cases insect galleries occupied by larvae were found inside these knobs.

In addition to cacao, gall-like structures similar to the cushion gall were observed by Kevorkian in mango trees used as windbreaks in the Buenos Aires area and at the Haciendas San Lucia and El Palmar in

[1] Regional Consultant in Plant Pathology, United States Foreign Operations Administration, and Plant Pathologist, Inter-American Cacao Center, respectively.

[2] Unpublished record.

Figure 1. Buba or cushion gall disease on cacao trees in Nicaragua.

Nicaragua. Orellana (3) observed galls on the wild avocado " tepe aguacate " (*Persea* sp.) near Rivas.

Investigations on Causal Agents

The cause of cushion-gall disease is uncertain. Kevorkian (1) regards the systemic nature of the disorder as an indication that it might be a virus. He observed mealy bugs in abundance on the affected trees and stated that these or other insects might serve as vectors. Other possible factors that have been suggested are infection by fungi, mineral deficiency or toxic effect and even the result of inheritance. Cushion galls are certainly due to an excessive stimulation of adventitious buds.

Fresh galls of all sizes were collected by Orellana in the Rivas area and were preserved for study in a fixative solution. These materials were sectioned within a few days and examined. It was found that the internal structure of the gall appeared somewhat porous and that the gall was formed by a whorl of buds as pointed out by Wellman (5), and those buds branch and develop into a massive growth of hypertrophied flower pedicels and other abnormal tissues. The cells of the cushions are enlarged and thick-walled and contain intracellular strands of what appears to be fungus mycelium. Isolations made on artificial media from fresh untreated pieces of tissues rendered colonies of *Fusarium*, *Trichoderma*, bacteria and a white, cottony, non-sporulating fungus, still unidentified. It seems also quite significant that mites were found abundantly both in the very youngest small, greenish cushion galls and in those of more advanced

Figure 2. Abnormal flower cushions on an apparently self-incompatible cacao tree, La Lola farm, Costa Rica.

age. Other larger insects were found also harboring in the cushions, especially in old ones. Detailed histological studies are in progress.

In the Rivas area where the cushion-gall disease is very severe, Orellana (3) observed a conspicuous disorder on the leaves of cacao trees. These leaves were narrowed and mottled, presenting a sickle-leaf appearance, as in the case of zinc deficiency. The mottling was very severe and appeared to be very similar to what might be expected from the virus effect. There was also considerable dieback on the affected trees. In addition the Rivas area is constantly showered by volcanic ash originating in the Concepción volcano some miles away. The foliage of cacao trees can be seen whitened by the ashes. The effect of this has not yet been investigated.

Detailed research is necessary before any conclusions as to the cause of the buba or cushion gall can be made. The observations thus far suggest many lines of investigation to be followed.

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Plant Disease Situation in the United States[1]

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KNOWLEDGE of the distribution and importance of plant parasitic nematodes is accumulating with astonishing rapidity, as demonstrated by the frequency with which the subject has been dealt in this series of articles. The following are some further recent reports.

Soybean Cyst Nematode in North Carolina

A cyst-forming nematode tentatively identified as the soybean cyst nematode, *Heterodera glycines* Ichinohe, 1952, has been found parasitizing soybean (*Glycine max*) in southeastern North Carolina. In small areas where soybean plants were severely stunted and became chlorotic, numerous lemon-shaped female nematodes were found attaching to the roots. Soil samples from infested areas contained several thousand cysts per pint of soil. Males were also very numerous.

Other *Heterodera* species known to attack legumes are the pea cyst nematode, *H. göttingiana* Liebscher, 1892, and the clover cyst nematode, *H. schachtii trifolii* Goffart, 1932. Mature cysts of the soybean cyst nematode can be distinguished from those of the pea cyst nematode by the presence of dark bodies (brown knobs) at the posterior end, which are absent in the pea cyst nematode. The clover cyst nematode apparently does not attack soybeans.

A New Nematode on Rice in Texas and Louisiana

Radopholus oryzae (van Breda de Haan) Thorne has been found in soil and rice root samples from one location in Texas and from seven locations in southwestern Louisiana. The nematode has been reported as damaging rice roots in certain areas in Asia, but does not seem to have been recorded previously in the United States.

Plant Parasitic Nematodes in Louisiana

The following is a summary of records of known or suspected plant parasitic nematodes found in association with crop plants in Louisiana since 1950, including the results of host plant studies made under controlled conditions in steam-sterilized soil with some species:

Apelenchoides besseyi Christie, 1942, causing white tip of rice and dwarf of strawberry plants. Occurrence is general in the rice and strawberry belts.

Belonolaimus gracilis Steiner, 1942, in the vicinity of sugar cane roots in one locality.

Criconemoides annulatum Taylor, 1936, from soil in the vicinity of roots of snap bean and citrus.

Criconemoides sp. from soil in the vicinity of roots of sugar cane, cotton and sweet potatoes.

Ditylenchus sp. on *Phlox*, from greenhouse plants.

Ditylenchus sp. from soil surrounding roots of cotton plants.

Dorylaimus sp. from soil in the vicinity of roots of soybean, cotton, sugar cane, sweet potato, strawberry and many other plants.

Helicotylenchus nannus Steiner, 1945, from soil in the vicinity of roots of boxwood (*Buxus* sp.).

Helicotylenchus sp. from soil in the vicinity of roots of cotton, maize, sweet potato, strawberry, sugar cane and soybean. It occurred in greatest numbers in silt loam

[1] This report is based upon material submitted by Collaborators of the Plant Disease Epidemics and Identification Section, Agricultural Research Service, United States Department of Agriculture.

and sandy loam soils. Under experimental conditions, it propagated abundantly on lima bean, cotton, maize, sweet potato, strawberry, soybean and tomato. Root damage of these crops was not prominent. Only females were observed.

Hoplolaimus coronatus Cobb, 1923, from soil in the vicinity of roots of sugar cane, cotton and soybean.

Meloidogyne hapla Chitwood, 1949, from roots of strawberry and potato. This nematode has been shown to be a very destructive root parasite of strawberry under Louisiana conditions. Its distribution seems to be comparatively limited.

Meloidogyne incognita (Kofoid & White, 1919) Chitwood, 1949, from roots of cotton, sweet potato, lima bean, okra, tomato, Crowder pea, *Amaranthus* sp. and gardenia, mostly from northern Louisiana.

Meloidogyne incognita var. *acrita* Chitwood, 1949, from roots of cotton, snap bean, tomato, okra, cucumber, beet, mustard, fig, vegetable pear (*Sechium edule*), white clover, hairy vetch, *Lamium amplexicaule*, *Amaranthus* sp. and *Convolvulus* sp.

Nothotylenchus affinis Thorne, from soil in vicinity of sweet potato roots.

Paratylenchus sp. from soil in the vicinity of roots of snap bean, tomato, okra.

Pratylenchus brachyurus Godfrey, 1932, from roots of cotton, tomato, strawberry, lima bean, okra, cowpea, lespedeza, crabgrass, *Cassia chamaecrista*. Only females were observed.

Pratylenchus sp. from roots of sugar cane, occurring generally on sugar cane in the State. Few males were observed.

Pratylenchus sp. from soil in the vicinity of roots of sweet potato, okra and cotton and from roots of cotton. Males were relatively common.

Pratylenchus zeae Graham, 1951, from the roots of maize and from soils in strawberry fields. In sterilized soil, it propagated abundantly on maize but did not survive on the roots of strawberry. Only females were observed.

Psilenchus sp. from soil in the vicinity of cotton roots.

Pungentus sp. from soil in the vicinity of cotton roots.

Rotylenchulus reniformis Linford & Oliveira, 1940, from cotton roots.

Rotylenchus multicinctus Cobb, 1893, from soil in the vicinity of tomato roots.

Rotylenchus sp. from soil in the vicinity of cotton and lespedeza roots.

Trichodorus sp. from soil in the vicinity of cotton roots. In sterilized soil, it propagated readily and abundantly on cotton, maize, sweet potato and soybean. Root damage on these crops was not prominent.

Trichodorus sp. from soil in the vicinity of strawberry roots.

Trichodorus sp. from soil in the vicinity of sugar cane roots in sandy soils.

Tylenchorhynchus claytoni Steiner, 1937, from soil in the vicinity of roots of strawberry, azalea, maize and cotton. It propagated abundantly on the roots of maize and strawberry. Root damage on those crops was not prominent.

Tylenchorhynchus sp. from soil in the vicinity of roots of sugar cane, strawberry, camellia, sweet potato and rice. Pathogenicity on sugar cane has been demonstrated. In sterilized soil it propagated on sugar cane, rice, sweet potato, soybean, wild sweet clover and Johnson grass, but not on maize, cotton and common *Ligustrum*. The nematode occurs generally in sugar cane soils.

Tylenchorhynchus sp. from soil in the vicinity of sugar cane and sweet potato roots.

Tylenchorhynchus sp. from soil in the vicinity of cotton roots. It propagated abundantly on cotton and maize. Injury to the roots appeared to be minor.

Tylencholaimellus sp. from soil in the vicinity of sweet potato roots.

Tylenchus semi-penetrans Cobb, 1913, from roots of citrus in Placquemines Parish.

Xiphinema americanum Cobb, 1913, from soil in the vicinity of cotton roots.

Outbreaks and New Records

Austria

Federal Institute for Plant Protection, Vienna

Incidence of Fall Webworm in 1954

As in 1953 the main infestation of the fall webworm (*Hyphantria cunea*) in 1954 occurred in the north of the Burgenland, especially in the district of Neusiedler See. In the centre of the Burgenland the insect was observed only sporadically in individual communes. For the first time the pest made its appearance in southern Burgenland where it was reported to occur near Güssing. In Lower Austria there was no further spread. An increase in the intensity of attacks was reported only by several communes along the Czechoslovakian border. Some nests were found in gardens in Vienna.

The damage caused by the insect was restricted to four main host plants: *Morus alba*, *M. niger*, *Acer negundo* and *Sambucus niger*. On fruit trees and other deciduous trees only isolated nests were discovered.

Among natural enemies, only *Psychophagus omnivorus* Wlk. was found in 1954 attacking the larvae and sporadically also the pupae of the fall webworm. However, the percentage of parasitism was low. Wasps, spiders, sparrows, Coccinellidae and Neuroptera were predators of the caterpillars.

In most parts of the Burgenland and also in Lower Austria control consisted of mechanical measures in which the nests were cut off and destroyed. Chemical treatments were applied only in an area in the district of Neusiedler See, where DDT and BHC products were used with good results.

(The above information was received by FAO from the European Plant Protection Organisation).

Italy

C. SIBILIA

Plant Pathology Station, Rome

The Discovery of Dwarf Bunt

In addition to the two common species of *Tilletia*, *T. caries* and *T. foetida*, two other species, *T. triticoides* and *T. intermedia* have been reported in Italy in association with wheat bunt at many localities, with wide but rather localized distribution.

In the spring of 1954, reports were received from Piacenza that bunt-infected wheat plants were dwarfed, being about one-third smaller than healthy plants, had shortened internodes and abnormally short, erect spikes. In some instances, a single infected stem remained of normal size while the rest were stunted. An examination of the chlamydospores in the infected grains collected at Piacenza revealed that the chlamydospores measure from 18 to 21 μ in diameter, and are ornamented with polygonal reticulations up to 1.3 μ high and enclosed in a gelatinous sheath from 1 to 2.5 μ thick.

Due to the morphological characteristics of the fungus, the profound dwarfing of the host and the difficulty experienced in the germination of chlamydospores, this species was identified as *Tilletia brevifaciens* G. W. Fisch.

The discovery of this previously unrecorded species in association with bunt at Piacenza made it advisable to re-examine the many specimens of wheat bunt collected from other regions at the herbarium of the Plant Pathology Station, Rome. Although

this work has not been completed, certain collections from Milan, Parma, Campobasso and Messina were found to be identical with *Tilletia brevifaciens*.

At the present stage precise information on the geographic distribution of the dwarf bunt in Italy or the losses it causes is not yet available. Investigations are under way in order to learn more about the biology of this fungus and its prevalence in the wheat-growing regions with a view to its effective control.

United States

Plant Pest Control Branch
Agricultural Research Service
United States Department of Agriculture

Surveys of European Corn Borer and Cotton Boll Weevil in 1954

The results of abundance surveys carried out in the fall of 1954 revealed high populations of the European corn borer, *Pyrausta nubilalis* (Hbn.), in some maize-growing areas of the United States. For the 13 North Central States, the most important maize-producing region, populations in the fall of 1954 averaged 223 per 100 stalks of maize. An average of 114 per 100 stalks was found in a similar survey during the fall of 1953. In 12 Eastern States, however, the population dropped sharply from 65 per 100 plants in 1953 to 33 last fall.

In contrast to the heavy populations of the European corn borer, the boll weevil (*Anthonomus grandis* Boh.), a major pest of cotton, was found in about normal numbers in the fall hibernation surveys made in several of the principal cotton-growing States.

The development and intensity of infestations of either of these insects in the spring of 1955 will be dependent, of course, on the influence of winter climatic conditions as well as those during the 1955 season.

Yugoslavia

Federal Institute for Plant Protection, Belgrade

Incidence and Biological Control of Fall Webworm in 1954

On account of the increased intensity of the fall webworm (*Hyphantria cunea*) during its second generation in 1953, a further increase of the population was anticipated in 1954 but the actual outbreaks were even heavier than expected. In spite of the wide control operations, the pest developed rapidly under a favorable climate and in September the second generation caterpillars had caused complete defoliation of trees in the most heavily infested regions, such as Novi Sad, Varazdin, and Kikinda. At the end of the month, a sudden drop of temperature prevented the development of the third generation. However, the hibernating pupae were found to be extremely numerous and it is therefore expected that serious outbreaks will be repeated in 1955. The infestation areas in 1954 were extended further south and west than those in 1953.

The biological control project, towards which FAO has provided technical and financial assistance, continued in 1954 under greatly improved conditions. A laboratory equipped with temperature and humidity control was completed at Zemun by the end of 1953 and was ready for use before the parasites from North America arrived.

In 1954 a total of 6573 parasites of the genera *Meteorus*, *Hyposoter*, *Rogas*, *Apanteles*, *Mericia* and *Campoplex* were collected by the Commonwealth Institute of Biological Control at Ottawa and shipped to Yugoslavia for

laboratory rearing. Unfortunately during the shipment a certain mortality occurred in both adults and pupae.

Multiplication of *Hyposoter fugitivus* and *Rogas hyphantriae* on caterpillars of the fall webworm and other species proved feasible but was more difficult in the case of *Meteorus hyphantriae* and *M. bakeri*. Endeavours to make these four species hibernate in the laboratory, however, have so far failed. *Apanteles hyphantriae* was found to be an egg parasite and failed to hibernate in the adult stage. Experiments with this species will be carried out when eggs of the fall webworm become available in sufficient numbers. The cocoons of *Campoplex validus* received in 1954 have remained in diapause. Multiplication experiments with the tachinid fly, *Mericia ampelus*, were very successful. This parasite proved to be harmless to silkworm, because its larvae were readily killed inside the host after the penetration. It is planned that this species will be liberated in 1955.

The liberation of the introduced American parasites was started in 1954 on an experimental scale in the Voivodina region in the isolated village of Buljkes, which has numerous plantations of mulberry and fruit trees and where the fall webworm attacks had been very heavy in 1953. In total 194 specimens of *Hyposoter fugitivus*, 62 of *Rogas hyphantriae*, 602 of *Meteorus* sp. and 882 of *Apanteles hyphantriae* were used in four liberations during August and September. In general it was regretted that the liberations could not be started earlier in the season, for susceptible fall webworm larvae of the second and third instars as well as host eggs were abundant only during the first liberation. At the time of the third liberation all fall webworm larvae had developed too far to be readily attacked. The fourth liberation consisted of *A. hyphantriae* only, in order to check if this species could hibernate during its adult stage. On 22 September the preliminary results of the earlier liberations were checked. For this purpose belts of corrugated paper had been placed round tree trunks to provide for hibernating sites which could easily be inspected. In this way 30 cocoons of *A. hyphantriae*, 3 of *Meteorus bakeri* and 1 each of *H. fugitivus* and *R. hyphantriae* were found. In addition some pupae of *A. hyphantriae* were found on branches; at a second check in October the adults had emerged from most of these. These findings are encouraging and seem to indicate that quick acclimatization of the American parasites might be possible. On the other hand the facts that the cocoon of *R. hyphantriae* had been destroyed by *Dibrachys cavus* and a cocoon of *A. hyphantriae* yielded a chalcid wasp show clearly that indigenous hyperparasites must be expected to take a certain toll of the introduced American species.

Plant Quarantine Announcements

Egypt

Act No. 417 of 22 July 1954 relative to the protection of plants against plant diseases and pests proceeding from foreign countries, published in the *Journal Officiel du Gouvernement Egyptien* No. 104, 27 December 1954, repeals Act No. 61 of 12 June 1946 on the same subject. This new Act came into force on 27 January 1955. Orders previously issued for the execution of Act No. 61 of 1946, if not in conflict with the provisions of Act. No. 417, shall remain in force for a maximum period of six months from 27 January 1955,unless amended or repealed before the expiry of that period.

The main provisions of Act. No. 417 are as follows:

Importation prohibited.

1. Cotton (*Gossypium* spp.) plants, parts thereof, ginned cotton, unginned cotton (except medicated cotton and commercial samples), cotton wool, cotton seed and cotton seed hulls, cotton waste, and woven cotton. Cotton yarns, threads and cotton goods are excepted from this prohibition.
2. Hibiscus (*Hibiscus* spp.) plants and parts thereof, except dried flowers of *H. sabdariffa*, linen thread and fabrics thereof.
3. Plants and parts of plants of *Althaea* spp.
4. Plants and parts of plants of *Abutilon* spp.
5. Grape vine (*Vitis vinifera*) plants and parts thereof excluding fruits.
6. Mangoes (*Mangifera indica*) and their stones.
7. Citrus (*Citrus* spp.) plants and parts thereof, excluding fruits and seeds.
8. Sugar cane (*Saccharum officinarum*) plants and parts thereof.
9. Agricultural soil and soil containing organic matter.
10. Living pests affecting agricultural crops, in all phases of their development (excluding useful insects).
11. Bacterial and fungus cultures injurious to plants.
12. Plant waste and remains of plant products consumed aboard ships and other forms of transport.
13. Other parcels with mixed contents containing prohibited plants or plant products.
14. Bags, cases, receptacles of all kinds and all other objects used for the packing and transport of any prohibited article.

Importation restricted. The importation of the articles mentioned below is prohibited unless previous authorization has been obtained from the Ministry of Agriculture in accordance with the conditions governing such authorization. Postal parcels and parcels accompanying travellers as well as all consignments in transit are exempt from this requirement.

1. Useful insects.
2. Soil unsuitable for agricultural uses.
3. Medicated cotton and commercial samples of cotton.

Packings. No plant material, other than moss, shavings, sawdust, cork or other approved materials, may be used in the packing of the imported consignments, which should be packed in such a way as to facilitate inspection and disinfestation of their contents.

Infested or infected plant materials. Plants and plant products affected by diseases or pests which are non-existent in Egypt may not be imported. The Ministry of Agriculture, however, may authorize the introduction of certain affected plants and plant products, in cases where there is no risk that such introduction may cause damage to the country's crops or where it proves possible to destroy completely the disease or pest involved.

Shipper's statement. The shipper of any consignment of plants, plant products, and other articles to be determined by the Ministry of Agriculture, must submit to the Quarantine Officer, within 36 hours of the arrival of such consignment, a statement giving full particulars of the consignment. This requirement applies also to consignments in transit.

France

An Order of 8 November 1954 relating to the sanitary control of imported plants and to the fixation of inspection fees, published in the *Journal officiel de la République française* No. 262, 9 November 1954, revokes the Order of 5 March 1952 on the same subject (see *FAO Plant Prot. Bull.* 1 : 30-31, 1952) and certain other previous measures.

The provisions of the new Order concerning phytosanitary control are similar to those in the Order of 1952. The importation of the following commodities and their packings into the metropolitan area of France and the overseas Departments of Guadeloupe, Guyane, Martinique and Réunion, even if accompanied by official phytosanitary certificates, are subject to the control and inspection of the French Plant Protection Service.

1. Living plants and floricultural products, except flowers and dried or dyed leaves, etc.
2. Vegetables and garden plants, in fresh or comparable state, and dried pulses, unless they are frozen or imported in salt water, sulphurized water or water containing substances capable of preserving them during transportation.
3. Edible fresh fruits (unpeeled or peeled), dried and table fruits, excluding frozen fruits and fruits imported in salt water, sulphurized water or water containing substances capable of preserving them temporarily.
4. Green coffee, in the form of berry, parchment, bean or skin. Pepper (forms of *Capsicum*, excepting *C. grossum* and pimenta), paprika and other peppers.
5. Cotton seed. Seeds and fruits for sowing, with the exception of gramineous seeds, particularly of ryegrass.
6. Fresh or sliced basket willows.
7. Cacao beans and broken beans (not roasted). Pods, skins, shoots and peelings of cacao.
8. Garden soil, heather soil, marsh soil and lime soil, destined for cultivation.
9. Natural manures of plant origin.

News and Notes

Luxembourg and Yugoslavia Ratify the International Plant Protection Convention

The Governments of Luxembourg and of Yugoslavia, whose representatives signed the International Plant Protection Convention on 16 January 1952 and 6 December 1951 respectively, deposited the instruments of ratification with the Director-General of FAO on 13 January 1955 and 11 February 1955 respectively. The number of governments contracting to the Convention, including both signatory and adhering members, is thus, at the time of writing, twenty-six, namely: Argentina, Australia, Austria, Belgium, Cambodia, Canada, Ceylon, Chile, Denmark, Dominican Republic, Egypt, El Salvador, Greece, India, Iraq, Japan, Korea (Republic of), Luxembourg, Netherlands, New Zealand, Pakistan, Republic of the Philippines, Spain, Sweden, United Kingdom and Yugoslavia.

FAO Meeting on Olive Fly

The second FAO Meeting on the olive fly will be convened, in co-operation with the Greek Government, in Athens, Greece, 16 to 21 May 1955. All the governments in the Mediterranean area have been invited to participate.

The first meeting was held in Florence, Italy, in the spring of 1953. A great deal of progress has been made since then towards more effective control of this important pest of olives, but the work carried out in various countries has indicated a need for further consideration of the problem of toxic residues of insecticides. It is therefore anticipated that the second meeting will be attended by public health officers as well as entomologists.

The main items on the agenda of the second meeting are:

1. Evaluation of results of recent control investigations.
2. Toxicity hazards and toxic residues.
3. Biology and ecology of the pest in relation to a more efficient control program.
4. Biological control.
5. Proposals for new approaches to the problem.
6. Coordination of investigations.

Roma - Tip. del Senato del dott. Giovanni Bardi

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II Humid Tropics

Forestry Development Paper No. 5. $3.50, 17s. 6d.

Available in English.

A companion volume to *Handling Forest Tree Seed*, this paper gives descriptive notes on seeds of species suggested for experimental purposes in arid and semi-arid zones.

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Forestry Development Paper No. 6. $1.50, 7s. 6d.

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This paper deals with seed, nursery and planting practices for arid and semi-arid zones in the Near East, but undoubtedly has application to many other similar climatic zones of the world.

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